CHEM 341 INORGANIC CHEMISTRY Dr. A. H. Martin
Spring, 2010 HOSCI. 224
Office Hours: M W F 9:00 - 10:00 Office phone 610-861-1433
(or by appointment) Home phone 610-837-7294
email: martin@moravian.edu (please not after 10 PM)

Purpose

This course is a one-semester introduction to the field of Inorganic Chemistry beyond that covered in the General Chemistry course. Since a limited time is available, an in depth study of all the aspects of all the topics in the field will not be conducted. Instead, this course will present a survey of both theoretical and descriptive topics in Inorganic Chemistry. In particular, this course will cover the basic bonding theories that govern the chemistry of the elements, a brief survey of the chemistry of the main group elements, and a discussion of the transition elements and the complexes they form. The laboratory will involve the synthesis and properties of inorganic and organometallic compounds.

Course Expectations

Upon completion of this course a student should be able to do, but not limited to, the following:

- Describe qualitatively the wave mechanical model of the atom
- Ability to calculate effective nuclear charges
- Explain and Predict elemental periodic trends including electron configuration, atomic size, ionization energy, and electron affinity
- Explain electronegativity and the various approaches to its determination
- Draw Lewis structures and resonance structures for molecules containing a number of different nonmetal atoms
- Predict the three dimensional arrangement and deviations form the basic structures using the VSEPR theory
- Assign point groups to molecules and ions
- Draw and explain molecular orbital diagrams for both homonuclear and heteronuclear diatomic molecules
- Explain molecular orbital diagrams of polyatomic molecules
- Describe and use the various definitions of acids and bases
- Evaluate the strength of acids and bases from the structure of the molecule
- Describe and explain basic crystal structures
- Calculate the lattice energy of salts by thermodynamic and electrostatic approaches and explain the differences in the results
- Describe the working mechanism for light-emitting diodes, solar cells, and superconductuivity
- Describe of the bonding and basic chemistry of the main group elements
- Determine the structure, nomenclature, and various types of isomerization in coordination compounds
- Explain bonding in coordination compounds in terms of the crystal field and ligand field theories
- Explain and predict the reactions and mechanisms of coordination compounds
- Name and explain the chemical bonding in organometallic compounds
- Describe the use of organometallic compounds as catalysts

- Describe the roles of inorganic elements in the biological systems
- Work with substance in inert atmospheres
- Carry out basic synthetic techniques for inorganic molecules

Course Text

Shriver, D. and Atkins, A, *Inorganic Chemistry* 4th, Ed. (2006, W. H. Freeman and Co., New York)

This text book covers a wide range of topics and may not provide as much detail on some topics as you may like. In those cases, you should consult one or more of the books below. Copies of these books are available in the Chemistry Periodical Room, HOSCI 221 or from the instructor.

Supplementary Texts

Cotton, F. A. and Wilkinson, G., *Advanced Inorganic Chemistry, A Comprehensive Text*, 4th Ed. (1972, John Wiley and Sons, New York)

Purcell, K. and Kotz, J., *Introduction to Inorganic Chemistry*, (1980, Sunders Publishing Company, Philadelphia, PA)

Bowser, James R., *Inorganic Chemistry*, (1993, Brooks/Cole Publishing Company, Pacific Grove, CA)

Mackay, K. M., Mackay R. A., and Henderson, W., *Introduction to Inorganic Chemistry*, 5th, (1996, Chapman & hall, New York)

Housecroft C. and Sharpe A, *Inorganic Chemistry* (2001, Pearson Education, New York)

Miessler, G. L. and Tarr, D. A., *Inorganic Chemistry*, 3rd Edition, (2004, Pearson Prentice Hall, Upper Saddle River, NJ)

Course Format

The course will consist of three lecture - discussion sessions (a 50 minute class on Monday and 70 minute classes on Wednesday and Friday) and a weekly three hour laboratory (Monday 12:45 – 3:45). The lecture - discussion periods will be used to present and discuss the material in the assigned chapters. This will be done by brief introductory lectures on the material followed reviewing a set of assigned problems for each chapter. Students are expected to come to class having thought through the problems assigned for that period.

Attendance

Since this course will involve student participation in all class sessions, attendance and preparation for all sessions is required.

Course Grade

Hour Exams (3) .....….…55%
Laboratory .....…...25%
Poster/Presentation…….....…..…...15%
Class Attendance/Participation.……..…...5%

Your minimum letter grade will be determined as follows, when the % represents your final average calculated as described above.

A	93% and up	C	73 to 76%
A–	90 to 92%	C–	70 to 72%
B+	87 to 89%	D+	67 to 69%
B	83 to 86%	D	63 to 66%
B–	80 to 82%	D–	60 to 62%
C+	77 to 79%	F	Below 60%

Hourly Exams

There will be three hour exams in this course. The first two exams will be take home exams which are scheduled for approximately the week of **Feb. 15th** and the week of **Apr. 5th**. The **third hourly exam** will be given during the scheduled time during the final examination period on **Thursday, May 6 at 1:30 PM**. Each of these exams will be open book in nature. The exact material to be covered during each exam will be announced in class prior to the exam.

Class Attendance/Participation

Since a much of this course will be taught through active class discussion, class attendance and preparation will play a significant role in determining your course grade. This portion of the grade will be determined by reducing your score from, 100 % by 2 % for each unexcused class absence after the first. To get complete credit for attendance students need to come to class prepared to go over the assigned homework problems.

Poster Presentation

Shortly after Spring break, each member of the class will be expected to produce a poster on an assigned topic. This poster will be presented in class as part of a 15-minute presentation. In addition, it will be displayed in the Hall of Science for the remainder of the semester. Grading of the project will be based on 50 % accuracy and completeness of the material on the poster, 30% class presentation, and 20 % originality and creativity of the poster. More specific information on the poster will be supplied later in the course.

Academic Honesty

Collaboration between students is viewed by the instructor as a valid means of reviewing the material. However, since collected assignments are to evaluate the student's mastery of the material, there should be **NO EVIDENCE OF COLLABORATION ON LABORATORY REPORTS, HOMEWORK ASSIGNMENTS, QUIZZES, AND EXAMINATIONS**. If collaboration on a graded assignment is observed it will be viewed as a breach of academic honesty and will be penalized accordingly. For the first offense the grade of zero will be assigned to ALL parties involved for the assignment and reported to the Dean of the College as required by the Academic Honesty Policy of the College.

Tentative Class Schedule

(Specific Assignments for Each Chapter will be given when the chapter is covered.)

Topic	Text Assignment
Atomic Structure/Periodic Table	Chapter 1
Simple Bonding Theory	Chapter 2.1 – 2.6
Symmetry/Group theory	Chapter 7.1 – 7.5
Molecular Orbital Theory	Chapter 2.7 – 2.12
Exam #1	----------
Solid State Chemistry	Chapter 3 Chapter 23.17 – 23.18
Acid Base Theories	Chapter 4
Oxidation – Reduction	Chapter 5
Exam # 2	----------
Coordination Compounds	Chapters. 8
Electronic Structure of Coordination Compounds	Chapter 19.1 – 19.2
Reactions of Coordination Compounds	Chapter 20
Organometallic Chemistry	Chapter 21.1 – 21.5, 21.18, 21.21
Exam # 3	

Laboratory

The laboratory portion of the course will involve the synthesis and study of a variety of transition metal compounds. In order to minimize the overload on one piece of equipment, each student will be working on a different experiment each week. **It is the responsibility of the student to consult with the course instructor about the experiment during the week prior to that in which the experiment is to be done.** A laboratory schedule and references to the procedures will be handed out during the first week of class.

Laboratory References

While no specific laboratory text has been assigned for this course, the following texts will be available for the student to consult for procedures and safety techniques before the experiment is conducted. These texts are located in the Chemistry Periodical Room (HOSC 221), please see that they remain there for all students to use.

W. L. Jolly, *The Synthesis and Characterization of Inorganic Compounds*, (1970, Prentice Hall, Englewood Cliffs, NJ)

Z. Szafran, R. Pike, M. Singh, *Microscale Inorganic Chemistry: A Comprehensive Laboratory Experience*, (1991, John Wiley & Sons, New York)

R. Angelici, *Synthesis and Technique in Inorganic Chemistry*, 2nd Ed. (1977, W. B. Saunders, Philadelphia, PA)

G. Girolami, T. rauchfuss, and R. Angelici, *Synthesis and Technique in Inorganic Chemistry*, 3rd Ed. (1999, University Science Books, Sausalito, CA)

Art Ellis, et al, *Teaching General Chemistry: A Materials Science Companion*, (1993, American Chemical Society, Washington, DC)

Woollins, J. Derek, Editor, *Inorganic Experiments*, 2nd Ed, (2003,Wiley- VCH Verlag GmbH & Co. KGaA, Weinheim, Germany)

Tentative Laboratory Experiments

1. Internet Data Bases
2. Preparation of $[Co(NH_3)_5Cl]Cl_2$
*3. Solid State Structures and Properties
4. Preparation of SnI_4
5. Preparation of $[PCl_4][SbCl_6]$
*6. Preparation of Ferrocene, Preparation of Ferrocene Derivatives, Chromatographic Separation, and GC/MS Analysis – 3 Lab periods
*7. Preparation and Theoretical Calculation of $SnCl_4[OS(CH_3)_2]$ – 2 Lab Periods
*8. Preparation and Analysis of $NiCl_2(P(C_6H_5)_3)_2$ & $Ni(SCN)_2(P(C_6H_5)_3)_2$
9. Preparation of $Mn(acac)_3$

Laboratory Grade

The grade from the laboratory portion of the course will be determined 10 % from the formal laboratory reports and 15 % from the graded laboratory notebook experiments. These reports and notebooks will be graded **O** (outstanding - 100%), **S+** (above average - 95%), **S** (satisfactory - 85 %), **S-** (below average - 75 %), **U** (unsatisfactory - 60%), and **zero** for laboratory experiments not completed. If a laboratory period is missed, the student must make arrangements with the instructor as soon as possible to arrange for a mutually convenient time to make up the missed experiment.

Laboratory Notebook

As you should be aware from previous courses, ALL laboratory data should be recorded in a laboratory notebook. While each person keeps a notebook in accord with their personal preferences there are some basic requirements that should be included in all lab notebooks. The laboratory notebook should be a bound notebook and all data recorded using pen (not pencil). All entries should be dated as to when they were made. Ideally, these entries should be signed and signed by a witness. (This will not be required for the notebooks in this course.) While individual notebook styles may vary, they all need to be neat and readable. The pages must be numbered and an up to date table of contents needs to be located in the front. **Note: laboratory notebooks in this course will NOT be returned at the end of the course.**

There are two types of laboratory experiments in this course. Requirements for formal laboratory experiments are given in the next section. For ALL experiments your lab notebook should contain:

A brief description of what is to be done (written before coming to the laboratory)
A description of what was actually done, indicating any changes to the procedures made
All appropriate chemical equations: all data for the experiment, including the amounts of all reagents used and calculations carried out
Copies of all spectral measurements (these can be place in with tape or stapled in place)
Complete references as to the literature source of the procedures

All of the above should be recorded legibly and date when the information was added.

For experiments that only require a notebook write-up, the notebook should also include the answers to any assigned questions, and appropriate molecular structures.

Formal Laboratory Reports

For those experiments marked with an * a typed formal typed laboratory report will need expected. These reports are due on the date assigned by the instructor. Late laboratory reports will be penalized at a rate of 10% of the grade for each week that the report is late.

Contents of Formal Laboratory Reports

1) **TITLE** and **YOUR NAME**

2) **ABSTRACT** – a brief, concise (few sentences) summary of the experiment and the results obtained.

3) **INTRODUCTION** – a brief background as to the techniques used in the experiment and the theory behind any calculations conducted in the experiment.

4) **EXPERIMENTAL SECTION** – this section should reference the source of the procedure used and indicate any changes such as changes in amounts or other modifications of the procedure that were made. It also should indicate specifically the mane of any instruments that were used to make the measurements, excluding balances.

5) **DATA SECTION** – this section gives all data obtained in raw form, with information provided as to how the data was obtained. The data should be compiled into tables where appropriate. These tables may be included in the body of the report or as attachments. Graphs should be properly drawn and labeled. These can either be done by hand or by one of the various graphing programs available on campus. Original spectra and other instrumental output should be kept in your notebook. Copies, photoreduced to page size if necessary, should be included in your report. These should be numbered and attached to the end of the report, with reference made to the appropriate number in the body of the report (i.e. see spectrum number 3). Calculations should be shown here (percent yield, etc.) with a sample calculation provided.

6) **DISCUSSION and CONCLUSION SECTION** – the data should be evaluated and conclusions drawn from that data. These conclusions should be drawn from the data, not making the data fit any preconceived correct idea of what the results. If your data differ from those expected this should be indicated and a possible explanation of the reasons for this difference given. This section also should contain any suggestions regarding improvements to the experiment.

7) **REFERENCES** – references used should be cited according to the ACS format and included at the end of the report. See the ACS Style Guide located in the Chemistry Periodical Room.

Additional information on writing laboratory reports can be found in *A Short Guide to Writing About Chemistry,* 2nd Ed., by H. Beall and J.Trimbur (2001, Addison-Wesley Educational Publishers Inc., New York)

Laboratory Safety

Laboratory safety is extremely important in any laboratory situation, but especially so when synthesis is being carried out. To help insure a safe laboratory the following rules will be enforced.

1) All synthesis work **MUST** be carried out during the scheduled laboratory period. Other work such as spectra determinations may be carried out during the course of the week as long as the instructor is informed that the work is being done.

2) Safety Glasses must be worn by **ALL** people in the laboratory whether they are conducting an experiment or not. Injuries often take place simply because a person is in the wrong place at the wrong time.

3) All experiments are to be conducted in the hoods as much as possible. While materials are reacting the glass of the hood should be lowered for additional protection.

4) Students **MUST** discuss the safety aspects to the synthesis with the instructor prior to carrying out the experiment.

5) All common laboratory safety practices should be used at **ALL** times when working in the laboratory.